Die wissenschaftlichen Grundlagen der analytischen Chemie elementar dargestellt. Von W. Ostwald. Dritte Auflage. Pp. xi+221. (Leipzig: Engelmann, 1901.) Price M. 7.

THE services that Prof. Ostwald has rendered to physical science during the last quarter of a century are so numerous and so valuable that his writings cannot fail to exert considerable influence. In working out and extending the theories of van 't Hoff and Arrhenius he played a leading part in laying the foundations of physical chemistry; and in applying these principles to the consideration of the problems of analytical chemistry, he has effected a complete revolution in the methods of approaching that subject. In 1894 he published the first edition of the "Wissenschaftliche Grundlagen," and thus furnished us with scientific explanations of much that up till that time had been little more than mere empiricism; analytical processes were interpreted by him in the light of the theory of solutions and the ionic hypothesis, and thus new life was infused into a branch of science that had become almost moribund.

It is gratifying to think that Prof. Ostwald's efforts have been appreciated; and the fact that a third edition of this striking work has been called for is sufficient evidence of its success. The new ideas are beginning to take a firm root, and are already finding their way into the latest text-books on the subject.

It is to be hoped that teachers of practical chemistry will study the pages of this last edition of the "Grundlagen der analytischen Chemie," and arrange their methods of instruction on the new lines it suggests. With this end in view Prof. Ostwald has added a chapter containing descriptions of a number of experiments illustrating some of the more important principles on which analytical chemistry is based.

In conclusion, we would draw attention to the closing words in which the author advocates the use of as simple apparatus as possible, that the attention of the student may be concentrated on the chief features of the experiment. Coming from so brilliant an experimenter and so popular a teacher, the advice is worthy of special emphasis.

An Introduction to Modern Scientific Chemistry. By Dr. Lassar-Cohn. Translated by M. M. Pattison Muir, M.A. Pp. viii + 348. (London: H. Grevel and Co.)

THE German original of this book has already been noticed in these columns (vol. lxi. p. 51, 1899). It has been translated into smooth English by Mr. Pattison Muir, and it may be cordially recommended as a clear exposition of the leading facts and principles of chemistry, well adapted to the class of readers for whom it was written, namely, University extension students and general readers. It must be borne in mind that the book is not intended for those who are able to study chemistry with their own *hands*. The fifty-eight illustrations in the book are its worst feature, but they are by the author, and no doubt the translator had no choice but to reproduce them. A. S.

First Aid to the Injured. By H. Drinkwater. Pp. 104. (London: J. M. Dent and Co.; no date.) Price, 1*s.* net.

THE number and excellency of the illustrations are special features of this little book, and increase its interest and clearness, doing away also with the need of lengthy explanations. The proportion between the theoretical and practical parts is well maintained. The anatomical details are not by any means unduly prominent, but are only introduced in so far as they are necessary to enable the practical directions to be intelligently followed. The book can be strongly recommended as a clear and trustworthy instruction in "first aid."

LETTERS TO THE EDITOR.

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Solution of Cubic and Biquadratic Equations.

THE historical note in your last number by Sig. Vacca regarding the graphical solution of a cubic, given by Mr. T. Hayashi, reminds me that I had intended, when Mr. G. B. Matthews published his suggestion for the graphical solution of a biquadratic by means of two parabolas (NATURE, Nov. 16, 1899), to point out that he too had been anticipated, as will be seen by referring to a paper by Mr. R. E. Allardice in the *Proceedings* of the Edinburgh Mathematical Society (April 7, 1890), where it is shown that, with the exception of the case where the roots of the biquadratic are equal in pairs, the real roots of the general biquadratic can be found graphically by means of two equal parabolas having their axes at right angles, the one fixed and the other movable; and also that every cubic can be reduced to the form $y^3 \pm y + r = 0$; and then solved graphically by means of the fixed curve $y = x^3$ and the movable straight line $x \pm y = r$.

I may take this opportunity of calling the attention of elementary teachers to the fact, also dwelt upon in Mr. Allardice's paper, that the most convenient method of discussing the algebraic solution of the general biquadratic, and of testing whether any particular biquadratic is soluble by means of quadratics or not, depends on the familiar theorem that $ax^2+2hxy+by^2+2gx+2fy+c$ is decomposable into linear factors if $abc+2fgh-af^2-bg^2-ch^2=0$, and not unless. Along with the biquadratic $x^4+px^3+qx^2+rx+s=0$ (1) consider the equation $x^2-y=0$ (2). By interequational transformation it is obvious that the system (1), (2) is equivalent to the system composed of (2) and $qx^2+pxy+y^2+rx+s=0$ (3). Again, the system (2), (3) is equivalent to the system composed of (2) and $(q-\lambda)x^2+pxy+y^2+rx+\lambda y+s=0$ (4), where λ is a constant at our disposal. If λ be so chosen that the left hand side of (4) breaks up into linear factors; that is, if λ be a root of the cubic

$$\lambda^3 - q\lambda^2 + (pr-4s)\lambda + 4qs - r^2 - p^2 s = 0 \qquad (5),$$

then the system (2), (4) will be equivalent to two systems $y+\mu x+\nu=0$, $y=x^2$, and $y+\rho x+\sigma=0$, $y=x^2$. In other words, the four roots of (1) are the roots of the two quadratics $x^2+\mu x+\nu=0$, $x^2+\rho x+\sigma=0$.

The cubic (5) is not in general soluble by means of quadratics without the adjunction of a cube root: hence the solution of a biquadratic in general depends on the solution of a cubic and two quadratics.

The necessary and sufficient condition that the cubic be soluble by means of quadratics is that it have a commensurable root, which, if it exist, can be readily found by finding an integral root of another cubic of the form x^3+ax^2+bx+c, where a, b, c are all integral. The determination of μ, ν, ρ, σ then requires, in addition to rational operations with p, q, r, s, λ, merely the extraction of a square root.

To the tyro who is familiar with the elements of the coordinate geometry of the conic sections the rationale of the above process can be made evident by the consideration of the two line-pairs which contain the four points of intersection of two conics. It may be noted that, instead of the parabola $y=x^2$, we may use the rectangular hyperbola $xy=1$, the only difference being that we are led to a different cubic resolvent.

Considering the space usually given in English text-books of algebra to the discussion of equations which are soluble by means of quadratics, it is strange that few, if any, of their authors emphasise the fundamental fact that the reduction of a biquadratic which is soluble by means of quadratics can be effected by finding the rational root of a cubic equation. I fear that I too must plead guilty to this omission, which among other things I propose to make good in the next edition of vol. i. of my "Algebra." G. CHRYSTAL.

Edinburgh, April 26.

Electro-Chemistry.

ALLOW me to point out an omission unnoticed by your reviewer of Mr. Bertram Blount's book on practical electro-chemistry (p. 582). Mr. Blount refers to the electrolysis of gold ore as a failure (Haycraft's method).

The omission is probably due to the fact that the process in question (Riecken's) has not been worked on a large scale except during the last three or four months, though the patent is three years old. Its efficacy depends essentially on securing a clean mercury kathode in the form of a thin stream of mercury flowing over a nearly vertical copper plate.

The liquid containing the pulverised ore is a continually agitated solution of cyanide and the anode is of iron, as the electro-motive force, one and a half volts, liberates nothing more corrosive than cyanogen. The particles of gold are doubtless cleansed of the obstructing sulphide and tellurous films by the convection currents of ionised cyanogen and also, in a more direct way, by the current as it passes through each particle, making in effect one side of it a kathode and the other an anode, just as is seen if we suspend a piece of metal in an electrolyte between the electrodes and unconnected with either.

This simple invention may revolutionise the treatment of refractory ores, yet apparently the inventor could get no hearing for three years till, at his own cost, he erected apparatus on a working scale in West Australia. The facts are valuable as showing how great an interval separates German intelligence from British engineering practice.

Intelligence of any kind, foreign or native, must indeed have been wanting when huge works, regardless of cost, were erected in presence of the published electrolytic method which could have been effectually tested in a single vat.

JOHN HILL TWIGG.

IF, as your correspondent, Mr. Twigg, says, Riecken's electrolytic process has only been worked on a large scale during the last three or four months, it is not unnatural that Mr. Blount has omitted to describe it. In most cases Mr. Blount has endeavoured to describe processes which are of proved utility, and therefore it was hardly necessary to draw attention to the omission. Further, the number of patents on the subject of electrolytic gold refining is very large, so that it would be manifestly impossible to describe them all. Riecken's process is a very neat one, and should any of the readers of NATURE be interested in the subject, an excellent description is to be found in the "Jahrbuch der Electrochemie" (vol. v. p. 380).

F. MOLLWO PERKIN.

Unusual Agitation of the Sea.

ON Wednesday, April 24, on going to the edge of the cliff above Alum Chine, Bournemouth, at 7.50 a.m., I was struck by the appearance of a succession of waves, resembling a slight ground swell, reaching the shore from an otherwise calm sea, there being no wind. The character of the waves was rather peculiar, and I then saw that every now and then, at intervals of about two or three minutes, much larger waves came in, and instead of breaking abruptly, extended quietly up the sandy beach to a greater height than was expected from their apparent elevation. I mentioned the phenomenon on reaching the house, and on the suggestion that the waves were the result of a distant storm, could not see that they might be so accounted for. Between 12 and 1 p.m. I again watched the undulations, and roughly measured the length on the beach by which the larger waves extended further than those of ordinary size. This was about 22 feet. The larger waves were less frequent than in the morning. Later in the afternoon, soon after 3 o'clock, some of my family were caught by the exceptionally large undulations, which rose surprisingly high upon the slightly sloping sand.

I have not heard whether any remarkable disturbance has been recorded by the seismometer, but I see in the *Daily Mail* and *Daily Express* of April 25 and 26 telegraphic reports of earthquakes in Italy, Portugal and Guernsey on April 24.

ROLLO RUSSELL.

RECENT DEVELOPMENTS IN ELECTRIC SIGNALLING.

IT is thirteen years since Hertz carried out the brilliant series of experiments which, apart from their great theoretical value, had the important effect of laying the foundation of modern systems of wireless telegraphy. Three years later we find the *Electrician* making the suggestion that the discoveries of Hertz might be utilised for signalling to lightships, and five years later still, in 1896, Signor Marconi brought over to England the first practical wireless telegraphic apparatus and awakened public interest by the remarkably successful experiments which he carried out on Salisbury Plain and across the Bristol Channel. For a time the technical and lay Press was full of wireless telegraphy; great prospects were predicted for it; communication with lightships and lighthouses was the least of the feats it would accomplish; telegraphy at sea was to become as common as on land; some even went so far as to say that wires and cables of all sorts for telegraphic purposes were to become a thing of the past. But these revolutionary changes, if they are ever to be made, did not come with the rapidity which many apparently expected. It was soon recognised that we needed to know a great deal more about the subject before Hertz waves were to be even a trustworthy servant to the telegraphist, and even now we can scarcely call wireless telegraphy much more than experiment. But we have now more definite grounds for feeling sure of its ultimate success, and we can predict for it a useful future with much more surety and reason than was done in the first outburst of enthusiasm that followed Mr. Marconi's experiments.

The patient and persevering experimenting of the past five years has led to the gradual surmounting of many of the difficulties which at first beset wireless telegraphy, and Mr. Marconi, Prof. Slaby and the other pioneers who have thrown themselves with vigour into its development have met with a success which, if not complete, is yet very promising. It is not the greatly increased distance over which it has become possible to signal, an increase from a few miles in 1896 to more than 200 in 1901, that marks the most important development that has occurred. The greatest achievement is the successful solution of the problem of tuning. It was early seen that before wireless telegraphy could have at all an extended utility it would be necessary to find some means of confining each message to its correct destination and of preventing each receiving apparatus from responding to Hertz waves sent out from any transmitter in its neighbourhood. It seems that now almost all experimenters have overcome this difficulty, at any rate to a certain extent.

The improvement in distance over which it is possible to signal has been very marked. The empirical law put forward by Mr. Marconi that, other things being equal, the distance over which signalling would be possible was proportional to the product of the heights of the masts at the two ends seems to be fairly well established as a working rule. But the improvements in transmitting and receiving apparatus have been so great that it is now possible to signal over much greater distances with the same heights of masts than was the case in 1898. For example, in 1898 Mr. Marconi was only able to cover 15 miles with vertical wires 120 ft. high, whereas to-day, according to the recent announcement made by Prof. Fleming, a distance of 200 miles from the Lizard to St. Catherine's, Isle of Wight, has been signalled over with masts only 160 ft. high. Mr. Marconi certainly holds the record for long distance work. The example just quoted refers to signalling across sea; across land such great distances have not been attained, but here again we think the credit of having signalled over the greatest distance must be given to Mr. Marconi, who established in 1899 communication between Dovercourt and Chelmsford, a distance of more than 40 miles.

These long distances have been attained by Mr. Marconi partly by the use of a specially constructed transformer in the receiving circuit. Instead of connecting the vertical receiving wire in series with the coherer it is connected in series with the primary of this transformer, the secondary of which is in series with a condenser and the coherer. By this means the voltage of